

When going hybrid is not enough: Statistical analysis of effectiveness of blended courses piloted within Tempus BLATT Project

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ABSTRACT

The paper describes the delivery of the courses in the framework of the project implementation and presents the effect the change in the methodology had on student performance as measured by final grade. Methodology: University of Pristina piloted blended courses in 2013 under the framework of the Tempus BLATT project. The blended learning approach was tackled through a supplemental model where online component was added to unreduced seat time of the courses. A total of 791 students were observed. Student performance and attainment of learning objectives in traditional vs. blended courses were compared. Notwithstanding the improved students' performance in some of the courses, the overall grades were not significantly higher with the introduction of blended approach ($p>0.05$). Despite the divergence from the Gaussian curve, showing the prevailing low grades, teachers tend to estimate the attainment of the learning objectives favorable. The differences between final grades and learning objectives score ranks were highly significant.

Keywords: *hybrid learning, statistical analysis, learning objectives, constructive alignment.*

INTRODUCTION

A variety of terms are used in the literature to define 'hybrid learning', with many of these being synonymous to one another such as: mix-mode, melted, multi-method, integrated, blended, flexible, hybrid, e-learning, etc. However, the multitude of labels for a notion indicate that "no dominant model has yet been accepted as a definition of standard practice" (Dziuban, Hartman, & Moskal, 2011). Terms 'blended' and 'hybrid' seem to be the most frequent in literature and are often alternately used. Nonetheless, Friend (2013) points out a distinction between the two terms that complement our implementation of the approach within the Tempus BLATT project.

In other disciplines, the term *hybrid* is far more common, with *blended* being used parenthetically just to make sure readers know what authors are talking about. Rather than being concerned with how to structure the specifics of a course, these fields are interested in helping students master the subject matter. To them, each delivery mode serves as a tool, allowing them to instruct students a different way. They emphasize the use of whatever delivery mode is most appropriate for the task that needs to be accomplished. (Friend, 2013)

The hybrid approach is rendered on a wide scale springing from the synthesis of various instruction methods with or without using technology (Torrisi-Steele, 2011; Verkroost, Meijerink, Linsten, & Veen, 2008). In addition, Shank (2011) defines it as a way to support learning with additional tools and resources, or as Purnima (2002) describes it: "learning that mixes various event-based activities". In contrast, other definitions signify the use of digital technology to improve student engagement and reduce seat time (Garrison & Vaughan, 2001). Dziuban et al. (2004) interpret the approach as the one that combines communal aspect of physical classroom with "active learning possibilities" of the online component. These authors are not interested in

“the ratio of the delivery modalities” but rather in the remodeling of the teaching and learning processes.

Hybrid learning and its effectiveness compared to the traditional course delivery is the focus of this paper; we have piloted our hybrid courses under the supplemental model which “retains the basic structure of the traditional course and uses technology resources to supplement traditional lectures and textbooks” (Westminster College, 2011). This model is based on the principle that synchronous oral communication is integrated with asynchronous written communication online to create “a unique learning experience congruent with the context and intended educational purpose” (Garrison&Vaughan, 2001).

METHODOLOGY

The comparison of the mean final grades and the achievement of the learning outcomes were investigated in the comparable courses delivered by the hybrid and the traditional face-to-face methodology. The courses were delivered in two consecutive school years (2012/13 and 2013/14, respectively), encompassing two generations of students, where the hybrid courses followed the traditional ones.

The implementation of the hybrid approach at the University of Pristina, Serbia was performed under the Tempus BLATT (Blended Learning: Advanced Teacher Training) project¹. Its primary focus is the systematization of teaching with digital technology at the University. Moreover, the project hinges on the introduction of student-centred learning, as well as the revision of the European Credit Transfer System (ECTS) in the given context (Tempus BLATT, 2013). The project aims, however, not only to engraft new methodology, but to induce thorough changes of the curricula entangled, which are expected to become the model for the wider curricular reforms throughout the university.

The courses subjected to the analysis in this paper were added an online component not detracting from the contact hours prescribed by the study programme. The online component, virtual classroom, was realized through Moodle. The virtual classroom contains a comprehensive syllabus, course materials, and, depending on the nature of the course itself, activities and assignments that would supplement class work. The evaluation of the students' achievement encompassed the work they did in the virtual classroom. It was an integral part of the course.

Lecturers were supported in transforming their courses into hybrid by e-learning specialists from partner institutions. They implemented hybrid methodology with the significant part (one fourth to one third of the total) of the learning materials delivered online, while preserving the existing structure of the face-to-face lessons. Virtual training sessions in using Moodle, creating course materials, using open educational resources, and designing a course were organised via Adobe Connect software. In total, seven courses were piloted in the fall semester 2013/14: *Biology of exercise* at the Faculty of Sports and Physical Education; Project Management at the Faculty of Economy; *Contemporary English Language 1* at the Faculty of Philosophy; *IT in Environmental Protection* at the Faculty of Technical Science; and three courses at the Faculty of Medicine,

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Endocrinology, *Practical exercises in Paediatrics*, and *ECG Basics*. However, the optional IT in Environmental Protection course was canceled due to the low interest of the students. The courses were externally evaluated by the partner institutions (Tempus BLATT, 2014). Six of the seven piloted courses are the focus of the statistical analysis in this paper because the course *IT in Environmental protection* was cancelled due to low enrolment.

A total of 791 students were encompassed by the present study, 417 of whom took the traditional courses and 374 involved in the hybrid ones. Both generations of students had the same faculty admission criteria, implying the equivalent average success in high school and the equivalent entrance exam scores; they were highly matched concerning the conditions related to and the success they showed in the studies prior to the start of the respective courses. The age and the gender distribution between the two generations were not different. Moreover the course instructors were the same, and the assessment criteria for the two generations of the students were equal.

The statistical evaluations of the mean final grades and the attainment of the learning objectives (as evaluated by the course instructors) were performed using non-parametric *Mann-Whitney U* test. The comparisons were performed for the individual courses, as well as the overall scores obtained from all courses delivered.

The normality test was used for the estimation whether the data (e.g. final grades and learning objective scores) fit the Gaussian distribution, as well as for the determination of the divergence rate.

RESULTS

The comparison of the mean final grades in hybrid and traditional courses, comprising all participating students, showed a slightly better student achievement in the hybrid courses. However, the differences were insignificant as shown by the results of the statistical test analysis (Table 1).

Table 1: The results of the *Mann-Whitney U* test of the difference in final grades between the hybrid and traditional courses.

Method of teaching	The mean final grades
Traditional	6.88 +- 1.44
Hybrid	7.03 +- 1.55
Test Statistics	
Mann-Whitney U	7.22 X 10 ⁴
Wilcoxon W	2.02 X 10 ⁵
Z	-0.074
p (2-tailed)	0.931
p >0.05	

The results of the dissection of the individual courses are shown in the Table 2. The students in the three of the six courses had considerably ($p<0.05$) improved their achievements with the introduction of hybrid pedagogy, while no significant differences were registered in the three other

courses. Notably, the utmost improvement was achieved in those courses where preparation and planning of the lessons was neglected in the past; two of them were medical courses which traditionally rely primarily on personal level of scientific and medical knowledge and the skills of the instructors. Therefore, the introduction of the hybrid pedagogy was the opportunity for these instructors to, for the first time, develop a detailed plan of the course, including specific learning objectives, diverse methodologies, different assessment forms, etc. This was achieved through closely monitored alignment process and the implementation of wider theories of learning and through changes in assessment methodology. Previously, the lecturers were sovereign in curriculum design and course delivery and were not subject to evaluation and quality assurance procedures.

The similar may be inferred for the *Project Management* course. Therefore, it appears that the use of diversified pedagogical methods initiated by the creation of a hybrid course contributed to the improvement of the delivery, rather than the use of digital technology alone. However, this is to be confirmed in a subsequent multiple regression analysis, which will be the subject of a different study.

Table 2: The results of the Mann-Whitney U test of the differences in the final grades between the traditional and hybrid courses.

The course name	Traditional 2012/13 mean final grade	Hybrid 2013/14 mean final grade	Mann - Whitney U test results
Biology of exercise	6.62 +- 0.91	6.93 +- 1.29	p=0.08
Project Management	6.35 +- 1.32	6.89 +- 1.65	p=0.03
Contemporary English Language 1	6.86 +- 1.18	6.87 +- 1.79	p=0.96
Practical Exercises in Paediatrics	6.77+-1.59	6.35+-1.7	p=0.27
The ECG Basics	5.64+-1.06	6.33+-1.45	p=0.03
Endocrinology	7.077 +- 1.57	8.12 +- 1.12	p=0.0001

Considering the high number of failures and low scores noticed both face-to-face and hybrid courses, we tested the normality of the distribution of the final grades. The distribution of the grades on both the traditional and hybrid courses demonstrated an evident deviation from the normal Gaussian curve (Figures 1 and 2, respectively).

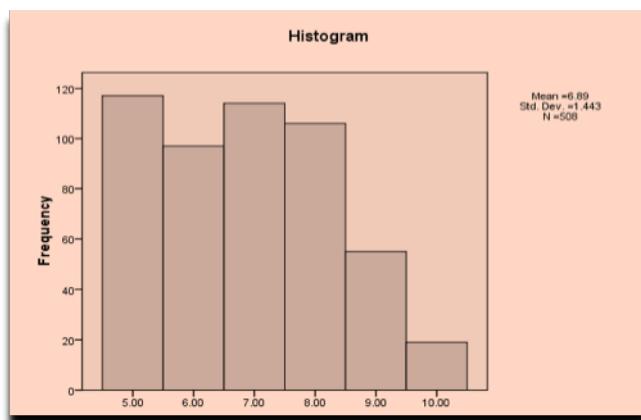


Figure 1: Distribution of final grades in traditionally delivered courses.

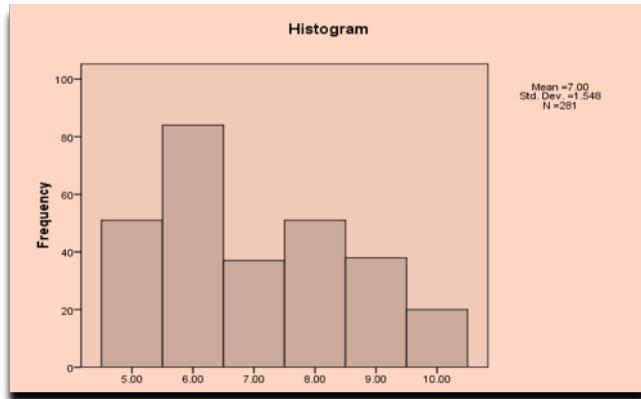


Figure 2: Distribution of final grades in hybrid courses.

Low scores (5, 6 and 7) far exceeded good and excellent ones with both methods of teaching. The divergence between the normal and the observed distributions of the final grades was highly significant ($p < 0.01$) with both types of courses, as evidenced by the results of the statistical normality tests (Tables 3 and 4, respectively).

Table 3: Test of normality of the distribution of final grades in traditional courses

Test of normality: Traditional courses					
Kolmogorov-Smirnova			Shapiro-Wilk		
Statistic	df	p	Statistic	df	p
0.152	508	$1,09 \times 10^{-31}$	0.913	508	$1,67 \times 10^{-16}$

Table 4: Test of normality of the distribution of final grades in hybrid courses

Test of normality: Hybrid courses					
Kolmogorov-Smirnova			Shapiro-Wilk		
Statistic	df	p	Statistic	df	p
0.239	222	1.07×10^{-45}	0.893	281	2.87×10^{-13}

The mean evaluation scores of the attainment of learning objectives, as assessed by the instructors, were significantly better with the hybrid pedagogy comparing to pure face-to-face delivery. Since the subsequent analysis revealed the non-Gaussian distribution of the scores, the use of the non-parametric *Mann-Whitney U* test was mandatory. Both *T*- and *Mann-Whitney U* tests showed highly significant differences in achieving the predicted learning objectives (Table 5, respectively).

Table 5: The results of the *Mann-Whitney U* Test of the differences in the attainment of learning objectives between the traditional and hybrid courses (as assessed by the course instructors).

Method of teaching	The mean learning objectives scores
Traditional	3.42 +- 0.61
Hybrid	4.06 +- 0.61
Test Statistics	
Mann-Whitney U	1404
Wilcoxon W	22.5
Z	-5.21
p (2-tailed)	0.0001
p < 0.001	

The results of the instructors' evaluation of the attainment of learning objectives in their own individual courses (1-5 scale, Table 6) also show the unanimous impression that these objectives were more advantageously achieved, comparing to the previous traditional courses; these convictions were confirmed statistically, by the results of the *Mann-Whitney U* testing of the differences between the evaluation results in hybrid vs. traditional courses.

Despite the fact that the teachers highly valued the improvement in attainment of the course objectives with the introduction of the new methodology, the relatively low mean grades in the majority of the courses contradicted the perceptions that the learning objectives were almost completely accomplished. The dissociation between the teachers' expectations and evaluation of their own efforts in creating and delivering the course contents and the students' achievements on the final exam was already marked with the traditional courses and even more so with the introduction of the hybrid methodology (see Figure 5). Moreover, the students fail to show significant improvement on the final exam in three of the six courses.

Table 6: The results of the Mann-Whitney U tests of the differences in the attainment of the learning objectives between the individual traditional and hybrid courses (as assessed by the course instructors).

The course name	Traditional course 2012/13 mean learning objectives grade	Hybrid course 2013/14 mean learning objectives grade	Mann - Whitney U test results
Biology of Exercise	3.72 +- 0.56	3.97 +- 0.50	p=0.03
Project Management	2.66 +- 0.81	4.33 +- 0.52	p=0.03
Contemporary English Language 1	3.14 +- 1.21	3.96 +- 0.89	p=0.01
Practical Exercises in Paediatrics	3.33 +-0.81	4.33 +-0.51	p=0.03
The ECG Basics	3.08+-0.66	3.83+-0.41	p=0.0001
Endocrinology	3.08 +- 0.66	4.5 +- 0.54	p=0.006

Moreover, the test on the normality of the distribution of the instructors' learning objectives evaluation scores (Figures 3 and 4, Tables 7 and 8, respectively) showed a highly significant divergence from the Gaussian curve. Contrary to the final grades, however, the distribution of the learning objective scores deflected towards the highest levels with both methods of delivery, but especially with the hybrid.

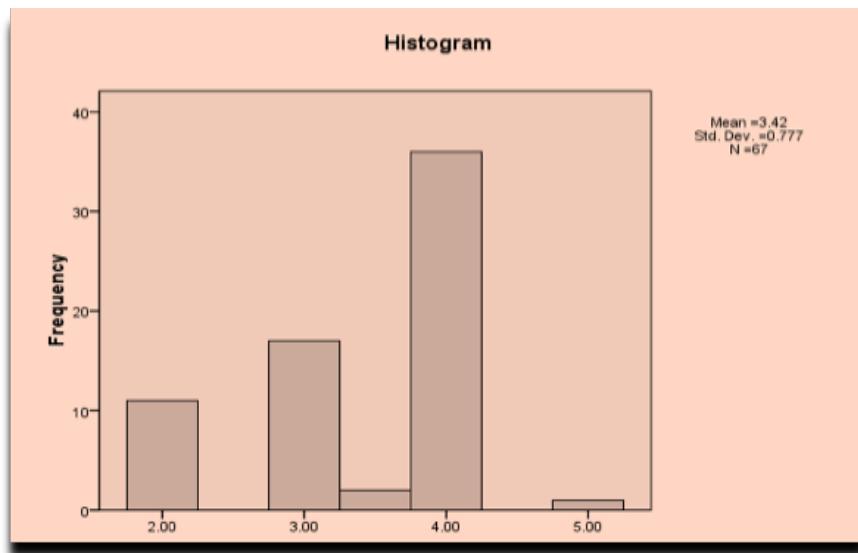


Figure 3: The distribution of the learning objectives scores in traditional courses

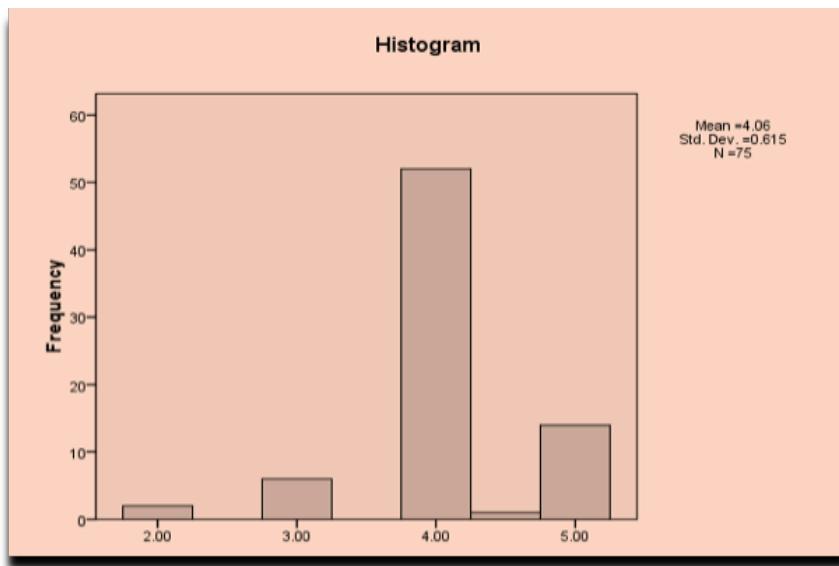


Figure 4: The distribution of the learning objectives scores in hybrid courses

Table 7: Test of normality of the learning objectives attainment scores in the traditional courses

Test of Normality: Traditional courses					
Kolmogorov-Smirnova			Shapiro-Wilk		
Statistic	df	p	Statistic	Df	p
0.325	67	1.08×10^{-19}	0.776	67	1×10^{-8}

Table8: Test of normality of the learning objectives attainment scores in the hybrid courses

Test of Normality: Hybrid courses					
Kolmogorov-Smirnova			Shapiro-Wilk		
Statistic	df	p	Statistic	df	p
0.354	75	2.04×10^{-26}	0.727	75	1×10^{-10}

Upon these findings, we ranked the learning objective scores, translating them in the 5-10 scale system in order to compare them statistically to the student final grades in the respective courses (table 9). The difference between these assessments was highly significant ($P < 0.001$), as

expected with the previous results. On the other hand, the traditional courses showed no significant diversity between the attainment of the objectives and the final grades.

Table 9: The system of ranking of the evaluation of the learning objectives with the aim of translation from 1-5 to 5-10 scale and comparing them with the final grades in the respective courses.

Score	Rank
5	10
4.5	9
4	8
3	7
2	6
1	5

There is a significant dissociation between the instructors' evaluation of the learning objectives that may be achieved in their hybrid courses, as well as knowledge and skills that students demonstrate in the exam (Table 10, Figure 5). This difference was a result of the exaggerated expectations of the instructors with the use of the new methodological approach. By the results of our study the changes in methodology of teaching alone, apart from the simultaneous modification in assessment methodology and the adjustment of the learning objectives, were apparently not sufficient to support tendencies towards more efficient learning.

Table 10: The results of the Mann Whitney U test of the differences between the student final grades and the learning objectives scores (as assessed by the course instructors) in the hybrid courses.

Test Statistics	
Grades vs. Objectives	
Mann-Whitney U	5511.5
Wilcoxon W	46266.5
Z	-6.618
p (2-tailed)	0.0001
P < 0.001	

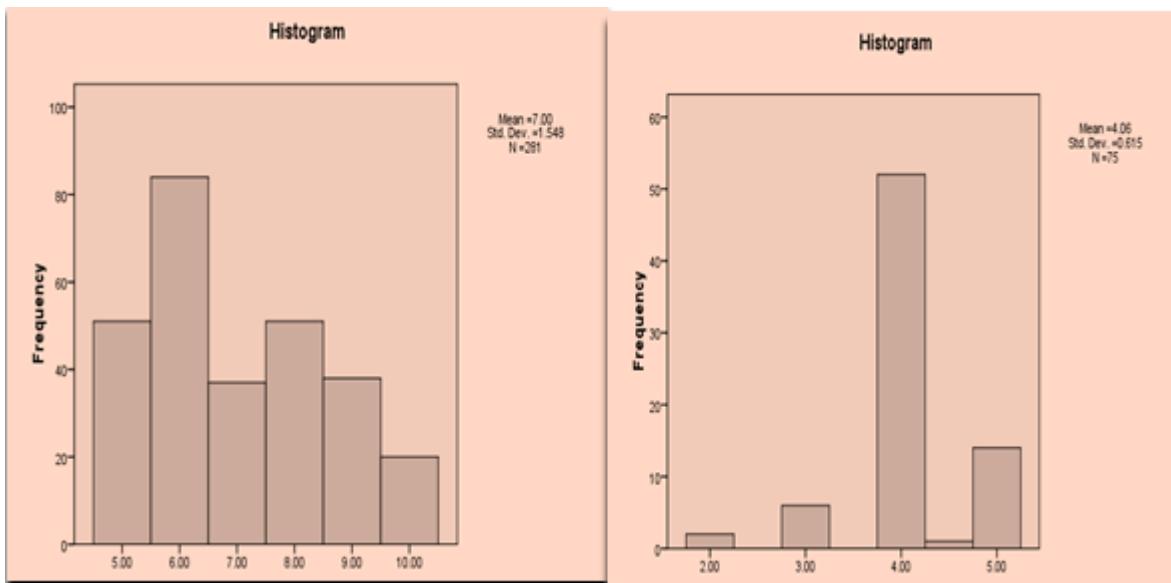


Figure 5: A comparative view of the student final grades and the learning objectives scores (as assessed by the course instructors)

In accordance with the concept of constructive alignment, if the learning outcomes within a given course or study program were not accomplished in a satisfactory way, the instructor should put additional effort in changing either learning methodology or assessment methodology or (in case neither of these succeed) the learning outcomes themselves. The instructor must take his share of responsibility for accomplishing the learning objectives, for the overall success in the exam, diversifying and modernizing the assessment methodology and, in particular, the introduction of regular evaluation of the objectives, learning methodology and assessment methods, instead of holding students responsible for any decline and inefficiency in the process; this could be a course towards the optimization of the studies and acceleration of the higher education reforms. Knowing that repeated changes in Serbian legislation concerning Higher Education in recent years had little effect, it is obvious that this kind of bottom-up incitement of the reform process may be more than welcome.

DISCUSSION

The review of the current research studies indicates that the hybrid learning “is now the preferred model for online course design” (Prece, Eshet-Alkalai, & Alberton, 2009). These studies suggest apparent dominance of hybrid over online learning for multiple reasons such as loneliness and social isolation, lack of cognitive skills, and lecture format being all too familiar. These issues are resolved in hybrid learning by combining brick and mortar classroom with its opportunities for social contact and online component of the course with its opportunities for collaborative learning (Means, Toyama, Murphy, & Baki, 2013). According to Kitchenham (2011), hybrid learning can achieve the goals and objectives of any higher education institution in the world. In addition, Dziuban et al. (2004) believe that hybrid courses can be the solution to the problems of “cost, access, efficiency, and timely degree completion”.

Banarjee (2011) poses a potent question whether the trend of increasingly moving to hybrid and fully online delivery of the courses in the tertiary education is “a desirable trend for smaller

institutions". She believes that learning effectiveness and student satisfaction are crucial in overcoming problems in "transforming face-to-face teaching to the technology mediated learning environments".

In addition, hybrid learning is not considered a transitional step toward online learning. On the contrary, the approach is "a discrete option which institutions choose on its own merits" (Allen & Seaman, 2006). The authors also note:

Most Chief Academic Officers believe that the quality of online instruction is equal to or superior to that of face-to-face learning. In 2003, 57% of academic leaders rated the learning objectives in online education as the same or superior to those in face-to-face. That number is now 62 percent, a small but noteworthy increase. Also, the proportion of those who believe that the online learning objectives are superior to those for face-to-face is still relatively small but has grown by 4 percent since 2003 from 12.1 percent to 16.9 percent. (p. 15)

In accordance to our results, the study by Willson et al show that "the withdrawal rates and failure rates were not significantly different between the two modes of course delivery" (Willson & Allen, 2011). However, other literature data (Capra, 2011) indicate that students undertaking study online or at a distance tend to have higher withdrawal rates. Moreover, the Montana State University study, which compared two versions of the same required electrical engineering course, using exactly the same instructional materials, indicates that student learning was not compromised in the online delivery version of the course. Plumb and LaMeres (2011) report:

Two groups of students, whose overall college grade point averages were no different entering the two versions of the course, received nearly an identical average final grade in the course and performed similarly on individual graded components in the course. (p. 7)

The United States Department of Education (2009) reports that there is some evidence that distinguishes blended learning in comparison to traditional or online teaching. The Department surveyed several hundred empirical researches and singled out 51 studies which measured learning objectives in the three learning modes. According to these studies, online and blended learning environments yielded better results, with blended learning performing significantly better. These results "are attributable in part to active learning strategies, which include opportunities for reflection and interaction with peers, and in part to the enriched content that characterizes well-designed online and blended courses" (U.S. Department of Education, 2009). McGee and Reis (2012) inform on common focus of such research studies "learner traits, grades, faculty member/learner levels of satisfaction, and/or levels of learner engagement".

A division of the Education Department that rates classroom curriculums states that "educational software is not an improvement over textbooks" (U.S. Department of Education, 2009). It has been noted that hybrid approach encompasses additional learning time, instructional resources, and course elements that encourage interactions among learners which leads to a conclusion that the combination of these elements is instrumental in advantages of the approach. Our results also pointed out that the success of the delivery was related mostly to the extent of the lesson preparation, clarity of the learning objectives, the selection of the additional materials prepared, the amount of time spent in lesson preparation, the diversity of the methodologies used; the courses with least pedagogical preparation in the traditional mode improved mostly when those elements were required of them during the creation of the hybrid course. Finally, Mean, Toyama, Murphy, and Baki (2013) emphasize the need for experimental testing of the course design for different types of learners. The U.S. Department of Education report (2009) further attests to this view:

Despite what appears to be strong support for blended learning applications, the studies in this meta-analysis do not demonstrate that online learning is superior as a medium. In many of the studies showing an advantage for blended learning, the online and classroom conditions differed in terms of time spent, curriculum and pedagogy. It was the combination of elements in the treatment conditions (which was likely to have included additional learning time and materials as well as additional opportunities for collaboration) that produced the observed learning advantages. At the same time, one should note that online learning is much more conducive to the expansion of learning time than is face-to-face instruction. (p. 18)

In the 2011 New York Times Article “In Classroom of Future, Stagnant Scores” by Matt Richtel, the 2009 report was opposed:

... they [digital technologies] may simply amplify what's already occurring — for better or worse. Good teachers can make good use of computers, while bad teachers won't, and they and their students could wind up becoming distracted by the technology.

Furthermore, Weber and Lenon (2007) came to a conclusion that students perform equally in both formats. Their analysis on means GPA (grade point average) showed that “course format had an insignificant contribution to learning achievements”. Previous knowledge and academic abilities were instrumental in deterring student performance in both course formats.

In a study “Blended Learning vs. Traditional Classroom Settings: Assessing Effectiveness and Student Perceptions in an MBA Accounting Course (Chen & Jones, 2007), in the multiple regression analysis, three of 12 actors were selected as the most dominant: “the quality of the instructor, the clarity of the instruction and the density of the course matter”. Additionally, meta skills needed for better attainment of learning objectives were analytical and computer skills.

In consistency with our findings, Nagel (2009) infers that appropriate mixture of instructional methods brings good results. He also adds that “jumping on the latest bandwagon or applying a single strategy across your whole course will seldom be successful”. Trends in e-Learning report (2006) stipulates that common issues arising from the growing number of instances of online delivery are “support staff needed for training and technical assistance, orientation/preparation for taking distance education classes by students and workload issues”.

The report of the study designed in a similar fashion with ours, is based upon a pilot-test of the implementation of four blended courses taught at the Harvard College in the fall of 2013 (Rutter, 2104). Their interpretation of blended learning is “the integration of online or other components into a residential educational experience” (Rutter, 2014). All the courses were previously taught face-to-face, although they varied in subject matter, course design, and instructional methods. Ruttler (2014) reports:

As many students were new to the concept of blended learning, they responded more to the course structure and execution than to the efficacy of specific online or blended elements. Students appreciated the high quality of the materials and a majority found them to be interesting and engaging. For the most part, students spent relatively the same amount of time outside of class (homework, preparation) in the blended versions as they would in traditional Harvard courses. Students valued the increased flexibility and ability to learn at their own pace, but still wanted meaningful in-person interactions with faculty and among themselves. (par. 11)

CONCLUSION

In conclusion, our study showed that the total student achievement in all six observed courses did not statistically differ among the blended and face-to-face instruction. Three of the blended courses – two medical courses and one at the Faculty of Economy - showed a significantly ($p<0.05$) better final grades compared to the traditional delivery. The courses where the improvement was most prominent were the ones where the lesson preparation in the traditional approach was the least adequate. The invested effort in preparation, clearer objectives and stronger connection between the learning objectives and the assessment expectations were instrumental in better student accomplishment, not the application of hybrid approach itself.

In all hybrid courses, teachers tended to overestimate the attainment of learning objectives (which were, according to their subjective evaluation, significantly better achieved with the use of hybrid methodology) and this was in sharp discrepancy with the student final grades. The constructive alignment of learning objectives, learning activities and assessment methods may be the best strategy to overcome this disparity and improve course delivery, the hybrid inasmuch as the traditional.

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